

REMARKS

Applicants thank Examiner Lipman for the helpful and courteous discussion of February 1, 2006.

After remand from the Board, the Office now rejects Claim 1 as obvious in view of patents to McDonald and Tomoi (U.S. 5,350,523). It appears that it is the Office's opinion that Claim 1 is obvious because the claimed invention is suggested by the combination of Tomoi and McDonald. The Office asserts that Tomoi discloses a monomer that has a functional group separated from an aromatic group by a methylene group and which may be used to form a membrane, and that such a monomer unit may encompass some species of the monomer units of formula (1) of present Claim 1. The Office further asserts that McDonald discloses a process that may result in the formation of a uniform mixture of different polymeric materials.

Applicants note that there are several important differences between the anion exchange membrane of present Claim 1 and any membrane that is disclosed in Tomoi and/or McDonald. For example, McDonald does not disclose the polymerizable monomer unit of formula (1). Present Claim 1 requires that the ammonium group linked to the aromatic center of the functional monomer is linked with an alkylene group that has at least 3 carbon atoms. In contrast, McDonald discloses that a methylene (e.g., a C₁) group must separate the ammonium group from the aromatic group of the monomer unit.¹

Therefore, McDonald does not disclose a membrane that can be made from a polymer that contains monomer units meeting the requirements of formula (1) of Claim 1 of the present application.

¹ In this regard, Applicants draw the Office's attention to new dependent Claim 17 which requires that the linking group is an alkylene oxylalkyl. Applicants submit that the cited prior art does not disclose such a monomer and therefore the subject matter of new dependent Claim 17 is further patentable over the prior art relied upon by the Office.

Applicants describe the importance of using the particular functional monomer recited on the claims on page 6, lines 13-17:

In the case of a C₁ or [C₂] alkylene group, the ammonium group having positive charge is susceptible to an influence of the benzene ring through the alkylene group, whereby the anion exchange groups are poor in heat resistance.

Thus, the use of a functional monomer having a functional group linked to the aromatic center by only a single carbon atom (e.g., a methylene group) results in an anion exchange membrane having poor properties.

Applicants provide a comparison of Example 1 and Comparative Example 3 in the specification of the present application. It was shown in the reply brief filed on October 23, 2003 that a side-by-side comparison of an anion exchange membrane made with the functional monomer of McDonald is unable to provide the performance properties of an anion exchange membrane made with the monomer unit of formula (1) of the present claims. (See page 4 of the Reply Brief filed on October 23, 2003).

Thus, on this ground alone, Applicants submit the data of the specification is sufficient for rebutting the Office's allegation of obviousness.

Tomoi may disclose monomer units that encompass one or more species of monomer units that fall under the description of the polymerizable component of formula (1) of the present claims. However, Tomoi does not disclose a uniform mixture of a thermoplastic polymer and a polymer that includes polymerized monomer units of formula (1) such as that recited in Claim 1.

Applicants demonstrate the advantages of using a substantially uniform mixture of a polymer having repeating units of formula (1) and a thermoplastic polymer in Example 1 and Comparative Example 1 on pages 17-20 of the specification. Comparative Example 2 is like Example 1 except that the thermoplastic polymer is not present. Importantly, in the absence

of the thermoplastic resin, the Comparative Example is shown to crack and provide poor anion exchange membrane performance (e.g., a static transport number of only 0.88).

Applicants have thus demonstrated that using a substantially uniform mixture of the thermoplastic polymer and the functional monomer-containing polymer is critical to obtaining a superior anion exchange membrane.

Thus, Applicants submit that the data of the specification are further sufficient for rebutting the Office's allegation that the claims are obvious because the prior art does not recognize the importance and benefits achievable by using a substantially uniform mixture of the functional monomer-containing polymer and a thermoplastic resin.

The Office states the following:

It would be *prima facie* obvious to use the precursor of Tomoi (citations omitted) in the method of McDonald (citations omitted) to make an anion selective membrane that has improved heat durability (citations omitted). (See page 2, paragraph 4 of the Office Action).

As mentioned above, Applicants submit that the data of the specification prove that substantially superior performance (e.g., no cracking of the anion exchange membrane) is achieved only when a thermoplastic polymer is present as a substantially uniform mixture with the functional monomer-containing resin phase and contains a certain monomer. Neither Tomoi nor MacDonald make any mention of nor recognize that such improved performance can be obtained.

Applicants have thus proven that two features of the presently claimed invention are critical to obtaining a superior anion exchange membrane; namely, (1) the inclusion of a monomer unit that is different from the functional monomer unit of McDonald, and (2) the inclusion of a thermoplastic polymer in the resin phase as a substantially uniform mixture with the functional monomer-containing polymer.

The Office asserts that Tomoi discloses that improved heat durability may be obtained if a functional monomer unit having an ammonium group separated from a benzene unit by at least three carbon atoms is used. Applicants have demonstrated however that such a monomer unit is unable to provide significantly superior performance in the absence of a thermoplastic polymer (e.g., as a substantially uniform mixture therewith). Claim 1 requires a particular monomer unit used as a substantially uniform mixture with a thermoplastic polymer. Simply having the correct monomer unit present is not sufficient for obtaining improved performance. Likewise, the presence of a thermoplastic polymer is not sufficient for obtaining improved performance in the absence of the polymerizable monomer unit of the present claims in the absence of a thermoplastic polymer.

Applicants thus submit that the subject matter of Claim 1 is not obvious in view of the cited prior art and respectfully request withdrawal of the rejection.

The prior art processes relied upon by the Office to reject Claim 5 as obvious do not disclose polymerizing a mixture of a halogenated vinyl monomer unit in the presence of a thermoplastic polymer to form a polymerized mixture, then subsequently converting the halogen units of the polymerized monomer to an ammonium salt.

Amended Claim 5 states that the polymerizable component is mixed with the thermoplastic polymer and the polymerizable component is thereafter polymerized. Applicants submit that those of ordinary skill in the art ready recognize that the resultant polymer may be, for example, one that does not have an ammonium group but instead has the “Z” group described in formula (1) of Claim 1.

Thus, the process of Claim 5 is different from the process of MacDonald which carries out polymerization of a monomer that is already in its final form (e.g., the hydrolyzed and/or amidated form). The claims process requires a separate step of amidation (i.e., the

converting recited in amended Claim 5) that occurs after the polymerizing. This is not possible with the process of MacDonald because the prior art monomer is already amidated.

Moreover, McDonald discloses at column 8, lines 5-24 that the following components are mixed: a powdered thermoplastic polymer, a functional monomer, a polymerization initiator, a cross-linking monomer and a leachable diluent. Thus the polymerizable component of the process of McDonald includes a compound that is a cross-linker (i.e., the cross-linking monomer).

Applicants submit that it is readily recognized by those of ordinary skill in the art that a process that includes polymerizing a monomer mixture including a cross-linker provides a product that is necessarily different from a process that includes polymerizing a monomer mixture that consists of monomer units that do not contribute to cross-linking. New dependent Claim 20 states that the polymerizable component consists of the monomer formula (2) and monomer units that do not contribute to cross-linking.

As was already noted above, the process of McDonald is one that must take place in the presence of a cross-linkable monomer. Applicants submit that the process of McDonald can no longer be applied as pertinent prior art to the subject matter of new dependent Claim 20 because new dependent Claim 20 excludes the processes of McDonald by the exclusion of cross-linking monomers in the invention anion exchange membrane.

Likewise, new dependent Claim 19 excludes the anion exchange compositions of Tomoi which comprise “using a cross-linked anion exchanger” (see Abstract). Because the anion exchange membrane of new dependent Claim 19 does not contain a cross-linker, the new dependent claim cannot be obvious in view of the cited prior art.

Applicants thus submit that the subject matter of new dependent Claims 19 and 20 is further patentable over the prior art relied upon by the Office and respectfully request withdrawal of the rejection.

For the reasons stated above, Applicants submit that all non-pending claims are in condition for allowance and respectfully request notification of the same.

Respectfully submitted,

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